FIG. 1

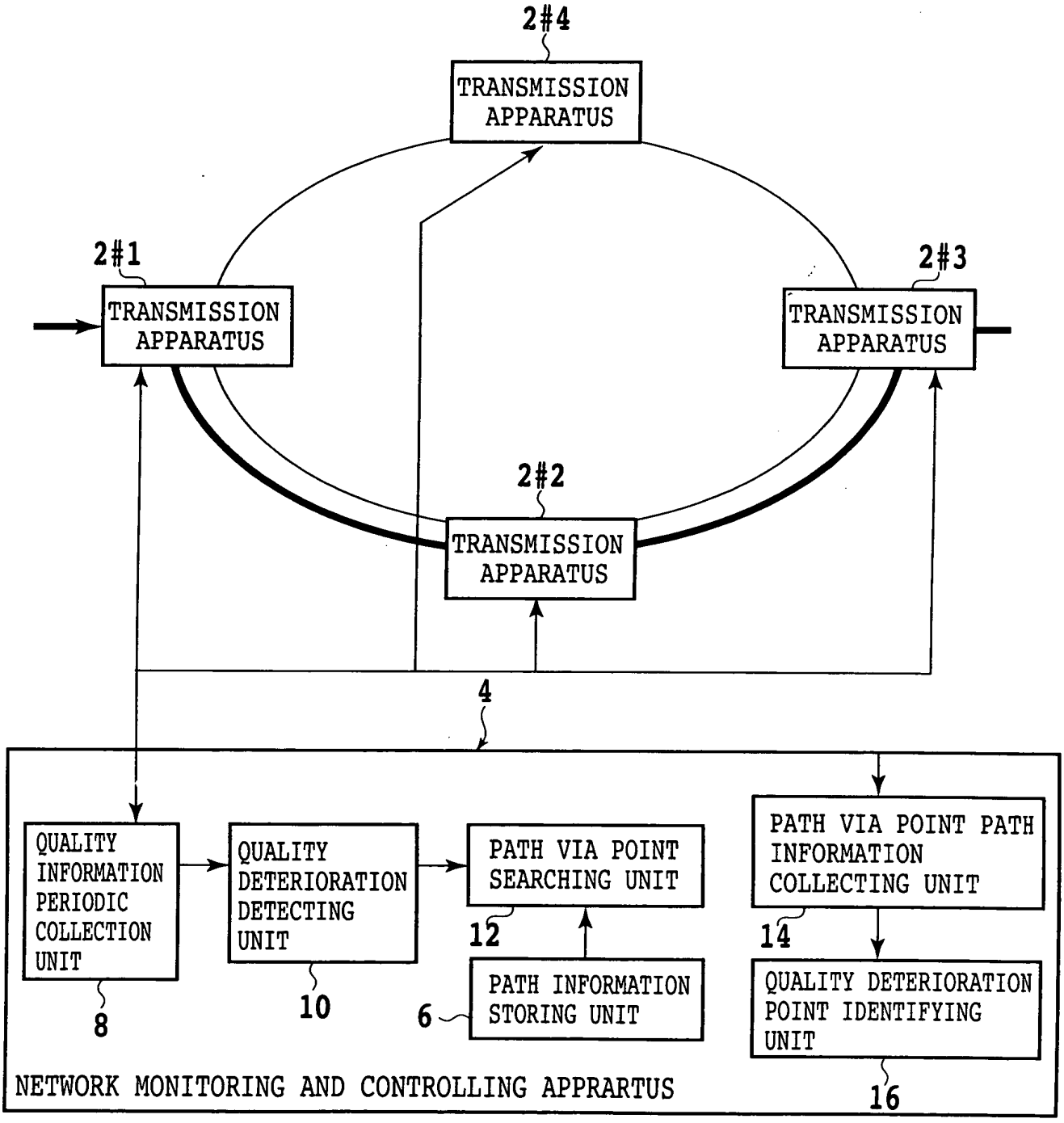
2#4
TRANSMISSION APPARATUS
2#1
TRANSMISSION APPARATUS
2#3
TRANSMISSION APPARATUS
2#2
TRANSMISSION APPARATUS
4
QUALITY INFORMATION PERIODIC COLLECTION UNIT
8
QUALITY DETERIORATION DETECTING UNIT
10
PATH VIA POINT SEARCHING UNIT
12
PATH INFORMATION STORING UNIT
6
PATH VIA POINT PATH INFORMATION COLLECTING UNIT
14
QUALITY DETERIORATION POINT IDENTIFYING UNIT
16
NETWORK MONITORING AND CONTROLLING APPRARTUS

FIG. 2

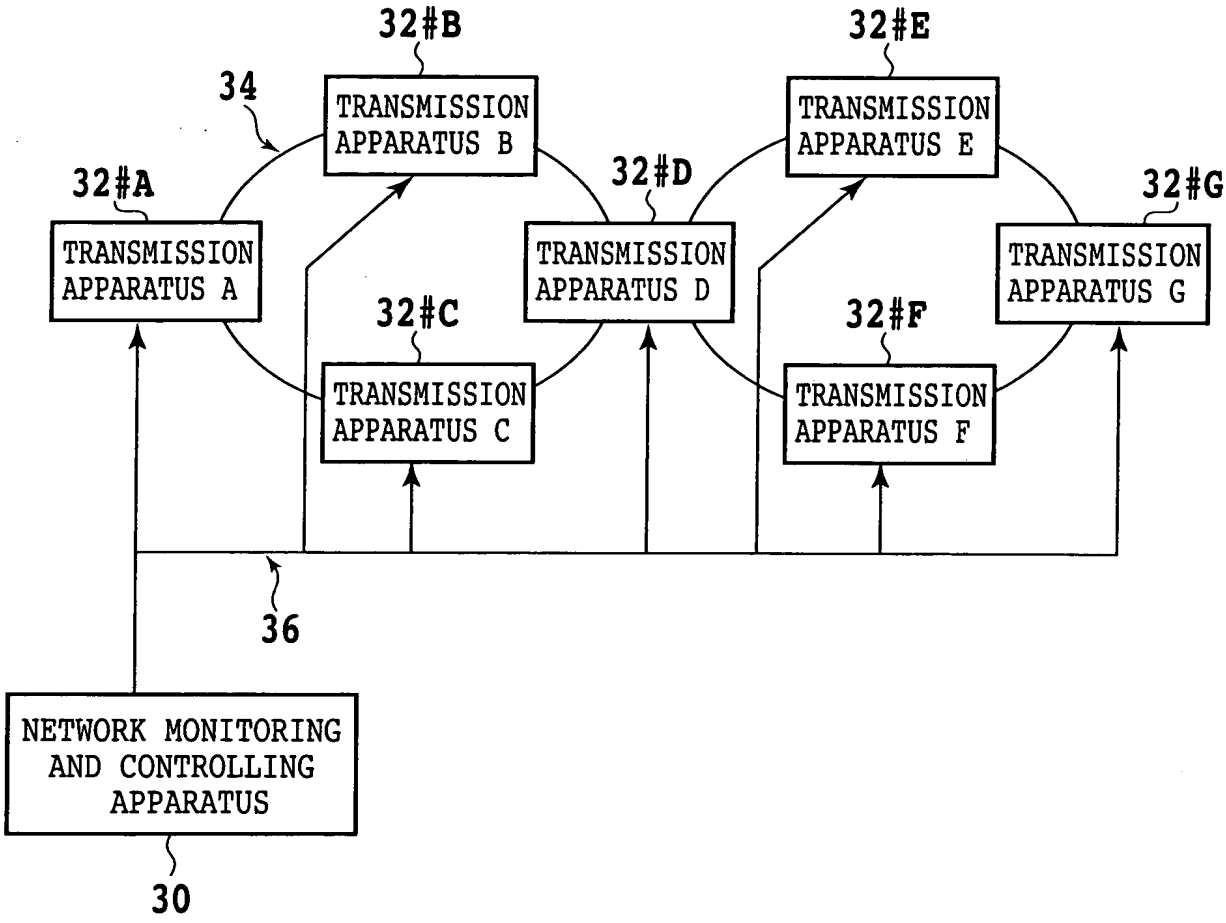
32#B
32#E
34
TRANSMISSION APPARATUS B
TRANSMISSION APPARATUS E
32#A
32#D
32#G
TRANSMISSION APPARATUS A
TRANSMISSION APPARATUS D
TRANSMISSION APPARATUS G
32#C
32#F
TRANSMISSION APPARATUS C
TRANSMISSION APPARATUS F
36
NETWORK MONITORING AND CONTROLLING APPARATUS
30

FIG. 3

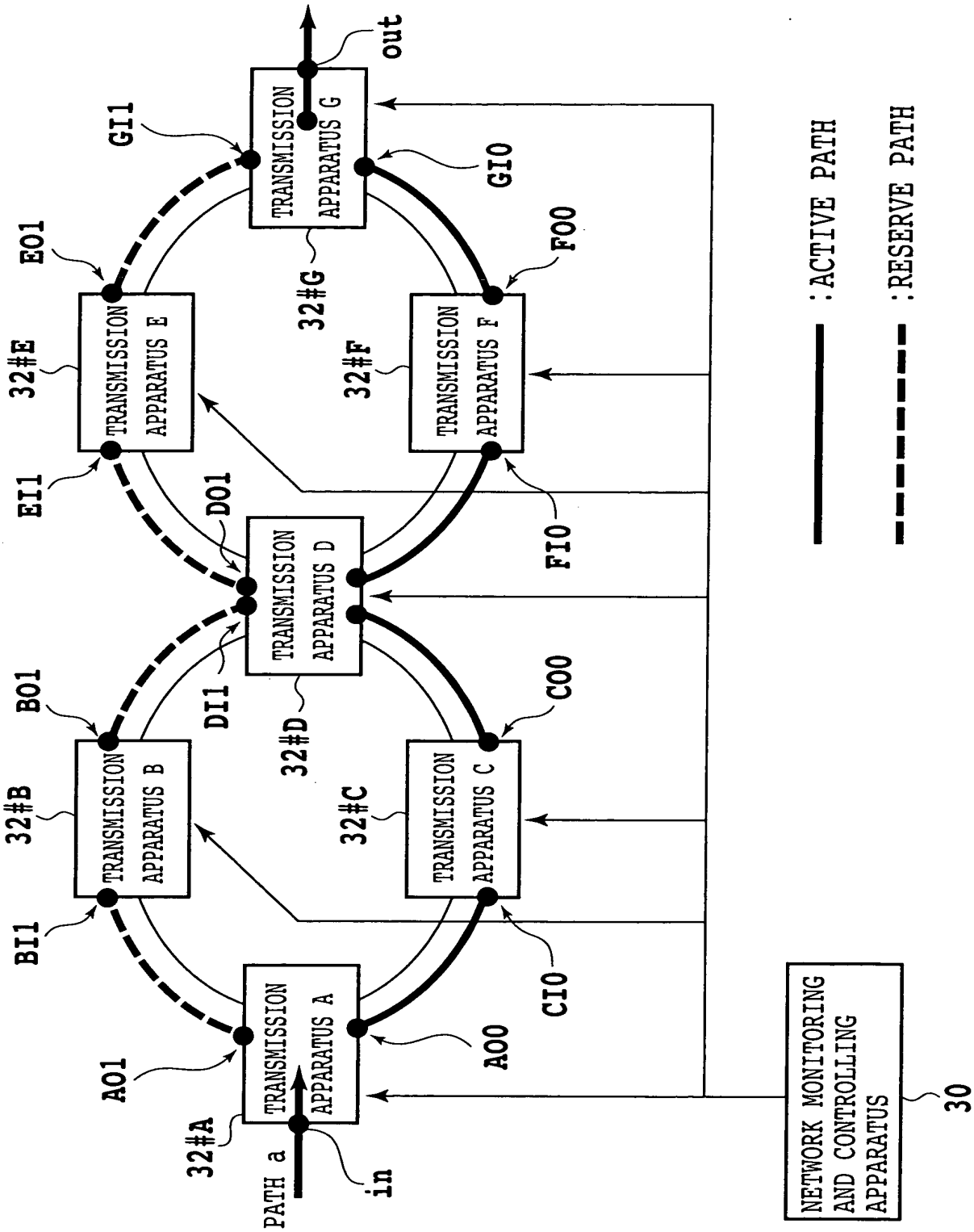
TRANSMISSION APPARATUS A
TRANSMISSION APPARATUS B
TRANSMISSION APPARATUS C
TRANSMISSION APPARATUS D
TRANSMISSION APPARATUS E
TRANSMISSION APPARATUS F
TRANSMISSION APPARATUS G
NETWORK MONITORING AND CONTROLLING APPARATUS
30
PATH a
in
out
32#A
32#B
32#C
32#D
32#E
32#F
32#G
AO1
AO0
BI1
BO1
CI0
CO0
DI1
DO1
EI1
EO1
FI0
FO0
GI1
GI0
:ACTIVE PATH
:RESERVE PATH

FIG. 4

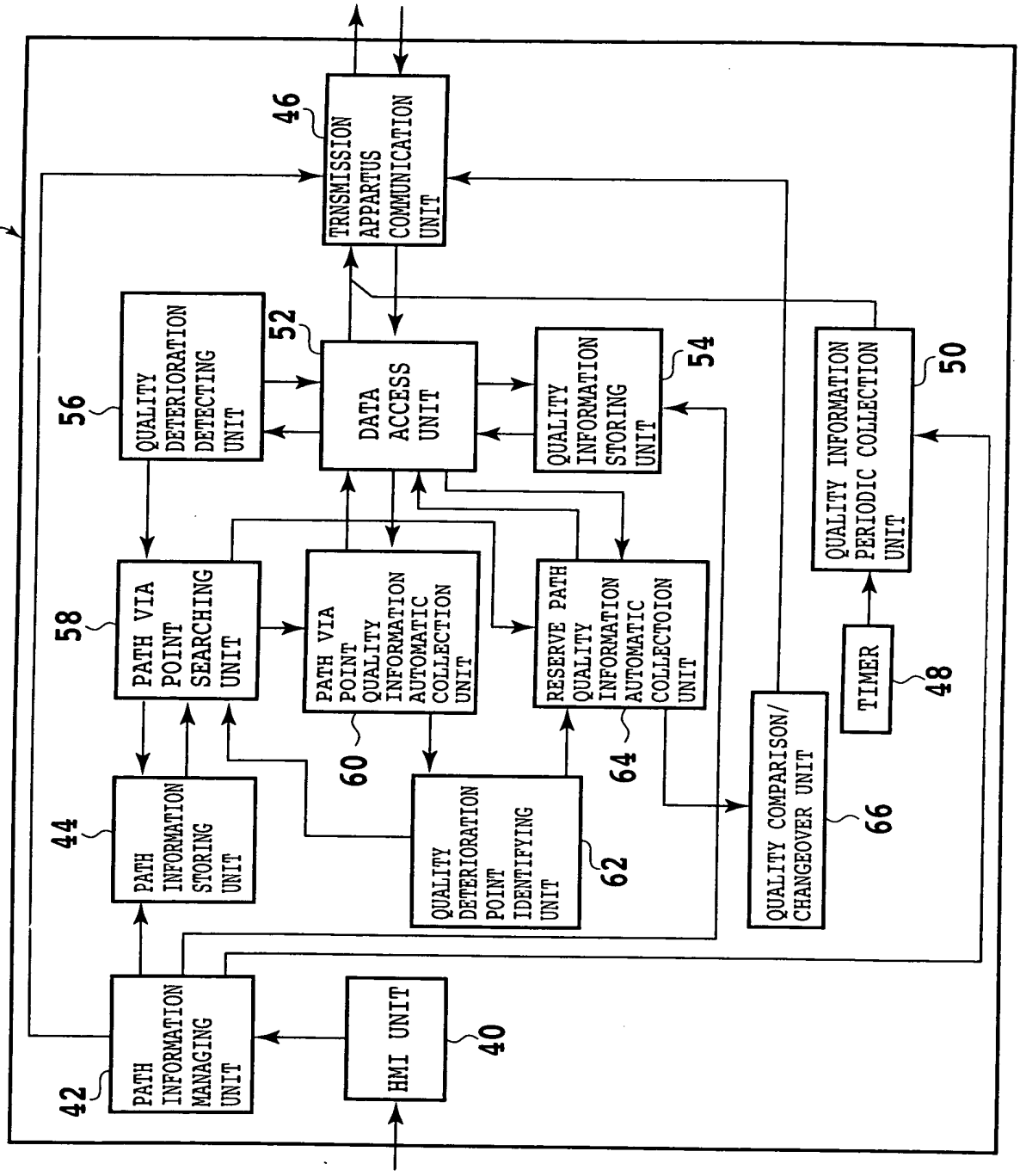
30
TRNSMISSION APPARTUS COMMUNICATION UNIT
46
QUALITY DETERIORATION DETECTING UNIT
56
52
DATA ACCESS UNIT
QUALITY INFORMATION STORING UNIT
54
QUALITY INFORMATION PERIODIC COLLECTION UNIT
50
PATH VIA POINT SEARCHING UNIT
58
PATH VIA POINT QUALITY INFORMATION AUTOMATIC COLLECTION UNIT
60
RESERVE PATH QUALITY INFORMATION AUTOMATIC COLLECTOION UNIT
64
TIMER
48
PATH INFORMATION STORING UNIT
44
QUALITY DETERIORATION POINT IDENTIFYING UNIT
62
QUALITY COMPARISON/ CHANGEOVER UNIT
66
PATH INFORMATION MANAGING UNIT
42
HMI UNIT
40

FIG. 5

PATH NAME	ENTRANCE	EXIT	INTERMEDIATE PATH	
PATH a	TRANSMISSION APPARATUS 32#A	TRANSMISSION APPARATUS 32#G	ACTIVE PATH	TRANSMISSION APPARATUS 32#C,32#D,AND 32#F
			RESERVE PATH	TRANSMISSION APPARATUS 32#B,32#D,AND 32#E
⋮	⋮	⋮	⋮	

FIG. 6

PATH NAME	POINT		QUALITY INFORMATION			
			PRESENT TIME	PRESENT -T1×1	. . .	PRESENT -T1×n
	ENTRANCE					
	EXIT					
	(entrance-exit) quality					
	QUALITY DETERIORATION					
	ACTIVE PATH INTERMEDIATE POINTS					
		⋮	⋮	⋮	⋮	⋮
	RESERVE PATH INTERMEDIATE POINTS					
		⋮				
⋮	⋮		⋮	⋮	⋮	⋮

FIG. 7

POINT		QUALITY				
		PRESENT TIME	PRESENT -T1×1	PRESENT -T1×2	. . .	PRESENT -T1×n
ENTRANCE(A)		0	0	0	. . .	0
EXIT(B)		3	3	0	. . .	0
(entrance-exit) quality		-3	-3	0	. . .	0
QUALITY DETERIORATION		DETERIORATED	DETERIORATED	NOT DETERIORATED	. . .	NOT DETERIORATED
ACTIVE PATH INTERMEDIATE POINTS	(C)	0	—	—	. . .	—
	(D)	0	—	—	. . .	—
	(F)	3	—	—	. . .	—
RESERVE PATH INTERMEDIATE POINTS	(B)	0	—	—	. . .	—
	(D)	0	—	—	. . .	—
	(E)	0	—	—	. . .	—

CONDITION FOR READING QUALITY INFORMATION OF INTERMEDIATE PATH : (entrance-exit)quallity BECOMES A NEGATIVE VALUE

FIG. 8

POINT		QUALITY				
		PRESENT TIME	PRESENT -T1×1	PRESENT -T1×2	・・・	PRESENT -T1×n
ENTRANCE(A)		0	0	0	・・・	0
EXIT(B)		3	8	3	・・・	0
(entrance-exit) quality		-3	-8	-3	・・・	0
THRESHOLD VALUE		-5				
QUALITY DETERIORATION		NOT DETERIORATED	DETERIORATED	NOT DETERIORATED	・・・	NOT DETERIORATED
ACTIVE PATH INTERMEDIATE POINTS	(C)	0	—	—	・・・	—
	(D)	0	—	—	・・・	—
	(F)	3	—	—	・・・	—
RESERVE PATH INTERMEDIATE POINTS	(B)	0	—	—	・・・	—
	(D)	0	—	—	・・・	—
	(E)	0	—	—	・・・	—

CONDITION FOR READING QUALITY INFORMATION OF INTERMEDIATE PATH :
(entrance-exit) quallity < THRESHOLD VALUE

FIG. 9

POINT		QUALITY				
		PRESENT TIME	PRESENT -T1×1	PRESENT -T1×2	・・・	PRESENT -T1×n
ENTRANCE(A)		0	0	0	・・・	0
EXIT(B)		3	8	8	・・・	0
(entrance-exit) quality		-3	-8	-8	・・・	0
THRESHOLD VALUE		-5				
CONSECUTIVE NUMBER		0	2	1	・・・	—
QUALITY DETERIORATION		NOT DETERIORATED	DETERIORATED	NOT DETERIORATED	・・・	NOT DETERIORATED
ACTIVE PATH INTERMEDIATE POINTS	(C)	0	—	—	・・・	—
	(D)	0	—	—	・・・	—
	(F)	3	—	—	・・・	—
RESERVE PATH INTERMEDIATE POINTS	(B)	0	—	—	・・・	—
	(D)	0	—	—	・・・	—
	(E)	0	—	—	・・・	—

CONDITION FOR READING QUALITY INFORMATION
OF INTERMEDIATE PATH : (entrance-exit) quallity
< THRESHOLD VALUE TWO CONSECUTIVE OR MORE

FIG. 10

POINT		QUALITY				
		PRESENT TIME	PRESENT -T1×1	PRESENT -T1×2	PRESENT -T1×3	・・・
ENTRANCE(A)		0	0	0	0	・・・
EXIT(B)		3	8	0	8	・・・
(entrance-exit) quality		-3	-8	0	-8	・・・
THRESHOLD VALUE		-5				
TOTAL NUMBER		0	2	1	1	・・・
QUALITY DETERIORATION		DETERIORATED	DETERIORATED	NOT DETERIORATED	NOT DETERIORATED	・・・
ACTIVE PATH INTERMEDIATE POINTS	(C)	0	—	—		・・・
	(D)	0	—	—		・・・
	(F)	3	—	—		・・・
RESERVE PATH INTERMEDIATE POINTS	(B)	0	—	—		・・・
	(D)	0	—	—		・・・
	(E)	0	—	—		・・・

CONDITION FOR READING QUALITY INFORMATION OF INTERMEDIATE PATH : (entrance-exit) quallity < THRESHOLD VALUE TWICE OR MORE IN TOTAL

FIG. 11

POINT		QUALITY				
		PRESENT TIME	PRESENT -T1×1	PRESENT -T1×2	・・・	PRESENT -T1×n
ENTRANCE(A)		0	0	0	・・・	0
EXIT(B)		3	8	6	・・・	0
(entrance-exit) quality		-3	-8	-6	・・・	0
THRESHOLD VALUE		-5				
QUALITY DETERIORATION		NOT DETERIORATED	DETERIORATED	DETERIORATED	・・・	NOT DETERIORATED
ACTIVE PATH INTERMEDIATE POINTS	(C)	0	0	0	・・・	—
	(D)	0	0	0	・・・	—
	(F)	3	8	6	・・・	—
RESERVE PATH INTERMEDIATE POINTS	(B)	0	0	0	・・・	—
	(D)	0	0	0	・・・	—
	(E)	0	0	0	・・・	—
QUALITY COMPARISON BETWEEN ACTIVE SYSTEM AND RESERVE SYSTEM		ACTIVE-RESERVE=8	ACTIVE-RESERVE=8	ACTIVE-RESERVE=6	・・・	—
THRESHOLD VALUE		7				
CHANGEOVER TO RESERVE PATH		—	PERFORM	—	・・・	—

CONDITION FOR CHANGING OVER TO RESERVE PATH :
VALUE OF QUALITY COMPARISON BETWEEN ACTIVE SYSTEM AND RESERVE SYATEM > THRESHOLD VALUE

FIG. 12

POINT		QUALITY				
		PRESENT TIME	PRESENT -T1×1	PRESENT -T1×2	・・・	PRESENT -T1×n
ENTRANCE(A)		0	0	0	・・・	0
EXIT(B)		8	8	6	・・・	0
(entrance-exit) quality		-8	-8	-6	・・・	0
THRESHOLD VALUE		-3				
QUALITY DETERIORATION		DETERIORATED	DETERIORATED	DETERIORATED	・・・	NOT DETERIORATED
ACTIVE PATH INTERMEDIATE POINTS	(C)	0	0	0	・・・	—
	(D)	0	0	0	・・・	—
	(F)	8	8	3	・・・	—
RESERVE PATH INTERMEDIATE POINTS	(B)	0	0	0	・・・	—
	(D)	0	0	0	・・・	—
	(E)	0	0	0	・・・	—
QUALITY COMPARISON BETWEEN ACTIVE SYSTEM AND RESERVE SYSTEM		ACTIVE-RESERVE=8	ACTIVE-RESERVE=8	ACTIVE-RESERVE=3	・・・	—
THRESHOLD VALUE		5				
CONSECUTIVE NUMBER		2	1	—	・・・	—
CHANGEOVER TO RESERVE PATH		PERFORM	—	—	・・・	—

CONDITION FOR CHANGING OVER TO RESERVE PATH : RESULT OF QUALITY COMPARISON BETWEEN ACTIVE SYSTEM AND RESERVE SYSTEM EXCEEDS THRESHOLD VALUE TWO CONSECUTIVE TIMES OR MORE

FIG. 13

POINT		QUALITY				
		PRESENT TIME	PRESENT -T1×1	PRESENT -T1×2	・・・	PRESENT -T1×n
ENTRANCE(A)		0	0	0	・・・	0
EXIT(B)		3	8	8	・・・	0
(entrance-exit) quality		-3	-8	-8	・・・	0
THRESHOLD VALUE		-5				
CONSECUTIVE NUMBER		0	2	1	・・・	—
QUALITY DETERIORATION		NOT DETERIORATED	DETERIORATED	NOT DETERIORATED	・・・	NOT DETERIORATED
ACTIVE PATH INTERMEDIATE POINTS	(C)	0	0	0	・・・	—
	(D)	0	0	0	・・・	—
	(F)	3	8	8	・・・	—
RESERVE PATH INTERMEDIATE POINTS	(B)	0	0	0	・・・	—
	(D)	0	0	0	・・・	—
	(E)	0	0	0	・・・	—
QUALITY COMPARISON BETWEEN ACTIVE SYSTEM AND RESERVE SYSTEM		ACTIVE> RESERVE	ACTIVE> RESERVE	ACTIVE> RESERVE	・・・	—
CONSECUTIVE NUMBER		3	2	1	・・・	—
CHANGEOVER TO RESERVE PATH		PERFORM	—	—	・・・	—

CONDITION FOR CHANGING OVER TO RESERVE PATH :
ACTIVE SYSTEM QUALITY > RESERVE QUALITY THREE CONSECUTIVE TIMES

FIG. 14

POINT		QUALITY				
		PRESENT TIME	PRESENT -T1×1	PRESENT -T1×2	・・・	・・・
ENTRANCE(A)		0	0	0	0	・・・
EXIT(B)		10	8	8	10	・・・
(entrance-exit) quality		10	-8	-8	-10	・・・
THRESHOLD VALUE		-5				
QUALITY DETERIORATION		DETERIORATED	DETERIORATED	DETERIORATED	DETERIORATED	・・・
ACTIVE PATH INTERMEDIATE POINTS	(C)	0	0	0	0	・・・
	(D)	0	0	0	0	・・・
	(F)	10	8	8	10	・・・
RESERVE PATH INTERMEDIATE POINTS	(B)	0	0	0	0	・・・
	(D)	0	0	0	0	・・・
	(E)	0	0	0	0	・・・
QUALITY COMPARISON BETWEEN ACTIVE SYSTEM AND RESERVE SYSTEM		ACTIVE-RESERVE=10	ACTIVE-RESERVE=8	ACTIVE-RESERVE=8	ACTIVE-RESERVE=10	・・・
THRESHOLD VALUE		9				
WHETHER THRESHOLD VALUE HAS BEEN EXCEEDED TWICE IN PAST FOUR TIMES		EXCEEDED	NOT EXCEEDED	NOT EXCEEDED	NOT EXCEEDED	・・・
CHANGEOVER TO RESERVE PATH		PERFORM	—	—	—	・・・

CONDITION FOR CHANGING OVER TO RESERVE PATH : RESULT OF QUALITY COMPARISON BETWEEN ACTIVE SYSTEM AND RESERVE SYSTEM EXCEEDS THRESHOLD VALUE TWICE OR MORE IN PAST FOUR TIMES

FIG. 15

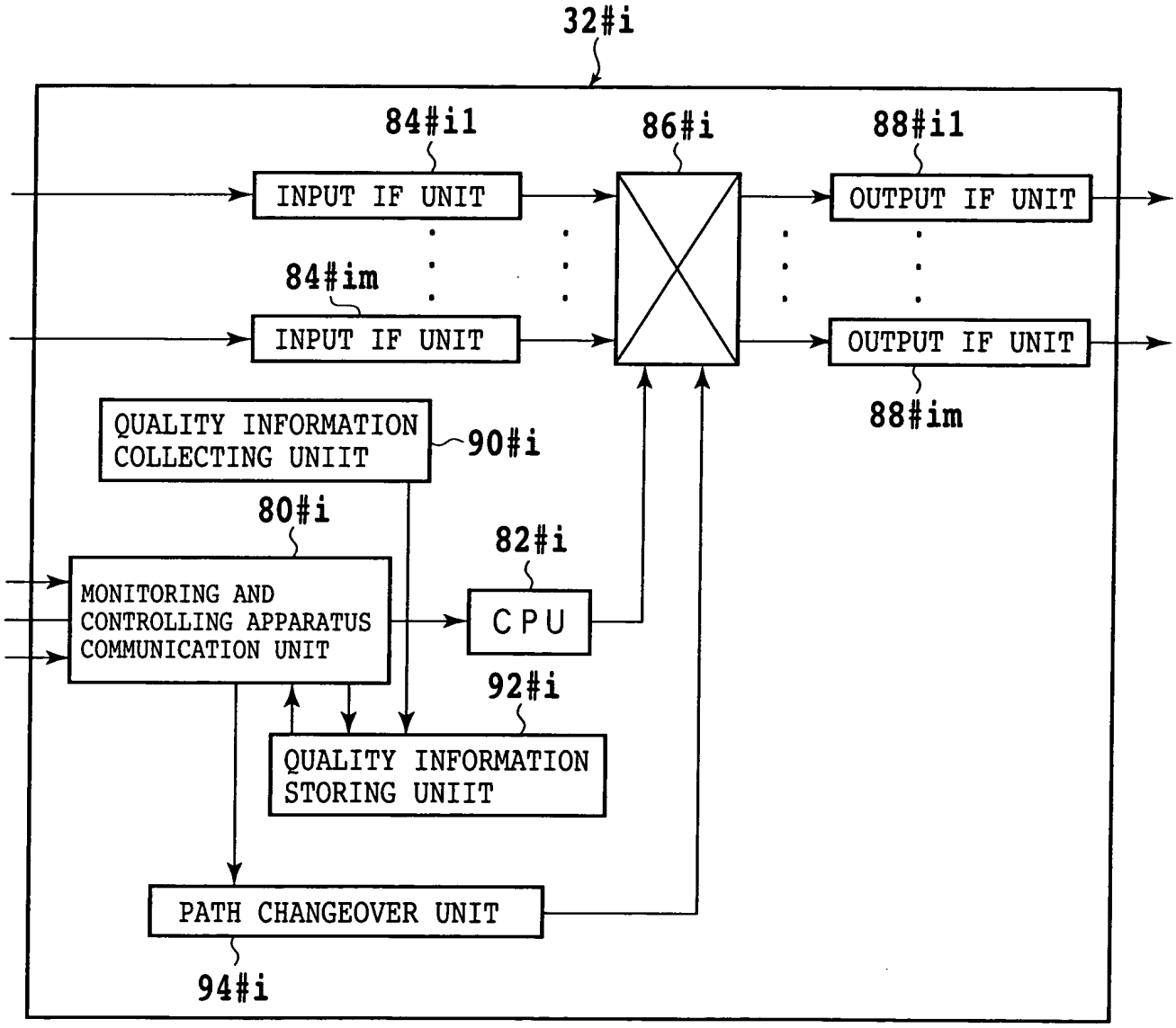
32#i
84#i1
86#i
88#i1
INPUT IF UNIT
OUTPUT IF UNIT
84#im
INPUT IF UNIT
OUTPUT IF UNIT
88#im
QUALITY INFORMATION COLLECTING UNIIT
90#i
80#i
82#i
MONITORING AND CONTROLLING APPARATUS COMMUNICATION UNIT
CPU
92#i
QUALITY INFORMATION STORING UNIIT
PATH CHANGEOVER UNIT
94#i

FIG. 16A

POINT	QUALITY				
	PRESENT TIME	PRESENT-T1×1	PRESENT-T1×2	• • •	PRESENT-T1×n
ENTRANCE(A)	0	0	0	• • •	0
EXIT(B)	0	0	0	• • •	0

FIG. 16B

POINT		QUALITY				
		PRESENT TIME	PRESENT-T1×1	PRESENT-T1×2	• • •	PRESENT-T1×n
ENTRANCE(A)		0	0	0	• • •	0
EXIT(B)		3	3	0	• • •	0
(entrance-exit) quality		-3	-3	0	• • •	0
QUALITY DETERIORATION		DETERIORATED	DETERIORATED	NOT DETERIORATED	• • •	NOT DETERIORATED
ACTIVE PATH INTERMEDIATE POINTS	(C)	0	—	—	• • •	—
	(D)	0	—	—	• • •	—
	(F)	3	—	—	• • •	—

CONDITION FOR READING QUALITY INFORMATION OF INTERMEDIATE PATH :
(entrance-exit)quallity BECOMES A NEGATIVE VALUE

FIG. 16C

POINT		QUALITY				
		PRESENT TIME	PRESENT-T1×1	PRESENT-T1×2	• • •	PRESENT-T1×n
ENTRANCE(A)		0	0	0	• • •	0
EXIT(B)		3	3	0	• • •	0
(entrance-exit) quality		-3	-3	0	• • •	0
QUALITY DETERIORATION		DETERIORATED	DETERIORATED	NOT DETERIORATED	• • •	NOT DETERIORATED
ACTIVE PATH INTERMEDIATE POINTS	(C)	0	—	—	• • •	—
	(D)	0	—	—	• • •	—
	(F)	3	—	—	• • •	—
RESERVE PATH INTERMEDIATE POINTS	(B)	0	—	—	• • •	—
	(D)	0	—	—	• • •	—
	(E)	0	—	—	• • •	—

CONDITION FOR CHANGE OVER TO RESERVE PATH :
ACTIVE > REESERVE